Objective: To assess the safety and efficacy of surgical excision of selected first branchial cleft cysts using electrophysiological rather than anatomical location of the facial nerve.

Design: Retrospective review of consecutive surgical procedures by a single surgeon, using a consistent technique during a 9-year period.

Setting: Tertiary pediatric medical center.

Patients: Eleven children with first branchial cleft cysts.

Interventions: Selected first branchial cleft cysts were removed using a smaller surgical approach than that generally advocated. The facial nerve was localized using electrophysiological means rather than superficial parotidectomy and identification of the nerve trunk and branches.

Main Outcome Measures: Successful removal of the lesion, avoidance of facial nerve injury, incidence of Fry syndrome, and cosmesis.

Results: Eleven patients underwent surgical excision of first branchial cleft cysts during a 9-year period. Ten lesions were removed without the need for anatomical localization of the facial nerve trunk. There was no facial weakness, recurrence of the lesions, or Fry syndrome during a follow-up of 6 months to 7 years. Cosmesis was superior.

Conclusion: Electrophysiological location of the facial nerve may, in the appropriate setting, replace anatomical localization for first branchial cleft cysts that are (1) superior to the stylomastoid foramen and (2) not previously infected or surgically violated.

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THE RELATIONSHIP of a first branchial cyst and its associated tract to the facial nerve is highly variable. Time-tested surgical procedures thus include the anatomical localization of the trunk of the facial nerve early in the course of the procedure. Most authors advocate a large preauricular and cervical incision to facilitate location of the nerve and its proximal branches as they perforate the substance of the parotid gland.

Continuous intraoperative electrophysiological monitoring of the facial nerve has become common practice for operations that place the nerve at risk. We have used intraoperative monitoring for all our first branchial cleft cyst excisions since reliable equipment became available in the late 1980s. Early in that experience, we observed that we could excise limited lesions in proximity to the ear canal without first performing a superficial parotidectomy, provided that the location of the nerve was confirmed electrophysiologically and that it could be determined that the lesion was cephalic to the nerve trunk.

We describe criteria for the safe excision of selected first branchial cleft cysts and review our experience with these lesions during a 9-year period.

RESULTS

Eleven patients underwent excision of first branchial cleft cysts during a 9-year period (1991-1999). They ranged in age from 22 months to 13 years, with a median age of 4 years. Seven lesions were located within the cavum concha and external auditory canal; 1 lesion was postauricular; 1 was located in the lobule; 1 imitated a preauricular sinus at the root of the helix, but extended into the middle ear, terminating at the neck of the malleus; and 1 was based in the cavum concha, but had a fistula tract to the postauricular area (Figure 4). This last lesion had been mul-

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MATERIALS AND METHODS

The pediatric operative logs of the Department of Otorhinolaryngology-Bronchoesophagology of Temple University School of Medicine, Philadelphia, Pa, were reviewed for the years 1991 to 1999. The records of all patients who underwent surgery for first branchial cleft cysts by the study's surgeon (G.L.) were reviewed to determine the location of lesion, operative procedure performed, technique of electrophysiological localization of the facial nerve, complications, and long-term follow-up.

The standard operative procedure for lesions anterior to or within the auricle (Figure 1) was as follows: A 2- to 3-cm incision in the preauricular crease was designed beginning at the junction of the root of the helix and the tragus and extending 1 cm below the external auditory canal. This incision could easily be extended inferiorly into a full parotidectomy incision if needed. For lesions within the cavum concha or external auditory canal, the incision was carried through the gap between the lobule and tragus. A narrow-field dissection was then undertaken. An ellipse of skin was excised overlying the cyst to include its sinus tract. If the sinus opening was inside the external auditory canal, care was taken to preserve as much canal skin as possible to prevent stenosis. The lesion was dissected free of overlying skin and soft tissues. If portions of the tragal or conchal cartilage were intimately involved with the lesion, they were excised in continuity with the cyst. Modifications (eg, postauricular middle ear exploration) were added as needed for specific lesions.

As the area of the stylomastoid foramen was approached, the location of the facial nerve was determined electrophysiologically (Figure 2). If the position of the nerve trunk was abnormal, the tissues around it were scarred or inflamed, or electrophysiological identification was equivocal, the nerve was identified anatomically by standard techniques and a superficial parotidectomy was performed.8,9 The lesion, its sinus tract, and closely associated soft tissues were then dissected free of the facial nerve and the specimen was removed (Figure 3). Auricular tissues were then reapproximated in layers. A split-thickness skin graft and canal stenting were used if more than 30% of the circumference of the external auditory canal was denuded.

Facial nerve electromyography (EMG) was performed using a 2-channel system with visual display and audio output (NIM or NIM-2; Xomed Inc, Jacksonville, Fla). One pair of needle electrodes was placed in the lateral margin of the orbicularis oculi, and another pair was placed in the lateral orbicularis oris muscles on the side that was operated on. Each pair was routed to 1 of 2 input channels on the EMG system. A needle ground electrode was placed in the high-midline forehead. A 60-millisecond time base was used to visually monitor the spontaneous, mechanically evoked and electrically evoked EMG activity of both channels. A trained clinical neurophysiologist performed the EMG monitoring.

Constant current stimulation was available to the surgeon on an as-needed basis. Current was generated using 200-microsecond pulses presented at a rate of 6/s. The pulses were presented through a handheld Prass monopolar probe. The current return was a needle electrode placed in the shoulder ipsilateral to the surgically treated ear. Current levels ranged from 0.1 to 0.5 mA, depending on the distance and thickness of tissue between the probe tip and the facial nerve. If a mechanically evoked EMG response was suspected, the clinical neurophysiologist would determine whether the activity was artifact (static discharge from metal instruments coming in contact) or whether the activity represented muscle contractions by visual inspection of the waveform presented on the monitoring system screen. The surgeon periodically stimulated the tissue during the surgical approach to differentiate between neural and nonneural structures. When healthy nerves were stimulated directly, the responses were generally documented at very low current levels (0.05-0.1 mA).10 Stimulation at higher levels suggested that intervening soft tissues overlay the nerve.

Tightly infected and previously incised and drained, while the others had not had major infectious complications. One child belonged to a family with branchio-oto-renal syndrome.

Ten children underwent surgery with limited incisions as described above. In 7 of the 10 children, the nerve was identified by direct electrophysiological stimulation. In 3, narrow-field dissection was accomplished without encountering the facial nerve. The child with a previously surgically treated lesion underwent a superficial parotidectomy and was found at surgery to have an inferiorly displaced facial nerve adherent to the nerve trunk.

All lesions were cured with a single operation (follow-up, 6 months to 7 years). There were no injuries to the facial nerve or its branches, no canal stenoses, and no clinically apparent Fry syndrome.

COMMENT

Considerable attention has been devoted to anomalies of the first branchial cleft in the last 40 years.11,12 An appreciation of the embryological origins of these lesions and their intimate association with the facial nerve has led to earlier correct diagnosis and safe treatment.13-15 Nearly every modern article on the subject and several recent atlases on pediatric otolaryngology16,17 describe the anatomical identification of the trunk of the facial nerve as a first step in the excision of branchial cleft cysts. This is a logical approach, as the best way to avoid injury to the facial nerve (or any important structure) is to know its location at all times during surgical dissection.

Work2 divided first branchial cleft lesions into types 1 (lesions limited to the first branchial groove) and 2 (lesions with contributions from the first and second arches as well). According to this classification, both types are regarded as duplications of either the membranous (type 1) or the membranous and cartilaginous (type 2) portions of the external canal. Neither type should be associated with pretragal cysts or sinuses. Type 1 lesions are epidermoid and contain no cartilage or adnexal tissue. If infected, they can drain inferiorly, medially, or posteriorly to the pinna. They
are superior (cephalad) to the facial nerve, usually parallel the ear canal, and end lateral to the tympanic annulus. Type 2 lesions are closely associated with the parotid gland, are made up of skin and adnexal structures, and, if infected, usually drain near the angle of the mandible. The inferior limbs of these lesions may pass medial or lateral to the facial nerve and, rarely, may divide its trunk.\textsuperscript{18}

In recent years, the clinical picture of first branchial cleft cysts seems to have shifted from that depicted by Work.\textsuperscript{2} Improved education among pediatricians and otolaryngologists has led to earlier diagnosis. In Arnot's\textsuperscript{19} 1971 series, patients with first branchial cleft cysts often presented in adulthood after repeated attempts at incision and drainage had failed or with chronic draining fistulae. In our series, only 1 patient had undergone previous, unsuccessful surgical drainage, and the median age at presentation was 4 years. Batsakis\textsuperscript{18} stated that first branchial cleft cysts represented fewer than 1\% of all branchial arch anomalies. We, by contrast, found first branchial cleft cysts to be relatively common. With 11 diagnosed in 8 years, this was our third most common branchial anomaly (following preauricular sinuses and second branchial fistulae in frequency). Several authors have found the division between type 1 and type 2 lesions on histological and anatomical grounds to be somewhat artificial. Leu and Chang\textsuperscript{20} and Olsen et al\textsuperscript{1} found several lesions in each of their series that did not fit exactly into either classification. We encountered a single lesion that fistulated to the postauricular area but in all other ways behaved as a type 1 lesion. Similarly, one of our patients broke Work's\textsuperscript{2} rules that first branchial cysts are unrelated to preauricular sinuses and terminate at the tympanic annulus. This patient's lesion began as a typical preauricular sinus, but cours ed down the external auditory canal, eroded the scutum, and indented the neck of the malleus. Tom et al\textsuperscript{21} report a similar exception.

Changes in the population of patients and advances in technology have led some authors to question classic surgical teaching as well. Nofsinger et al\textsuperscript{22} and Leu and Chang\textsuperscript{20} describe first branchial cleft cysts...
treated by “local excision” without facial nerve dissection. We believe that for cysts in and about the external auditory canal, electrophysiological identification of the facial nerve may be sufficient, if the surgeon observes certain precautions. Electrophysiological localization of the facial nerve trunk is ideal for simple cysts that have not been infected or previously surgically treated. Identification of the nerve trunk depends on stimulation at low current levels (0.1-0.25 mA). If tissues are scarred by previous recurrent infection or prior operative attempts, tissue resistance may be increased, giving the false impression that the nerve is far away. Similarly, if a sinus tract passes across the region of the stylomastoid foramen, it may be intertwined with the nerve trunk or branches. Anatomical identification is strongly recommended under these circumstances.

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REFERENCES